TRANSFER OF TRAINING EFFECTIVENESS OF A FLIGHT TRAINING DEVICE (FTD)

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An incremental transfer of training research design was used to measure the effectiveness of a flight training device (FTD) and to determine the point at which additional training in a FTD was no longer effective. The dependent measures were number of trials to specific completion standards, time to complete a flight lesson, and time to a successful evaluation flight. Percent transfer, transfer effectiveness ratios (TER) and incremental transfer effectiveness ratios (ITER) were computed for each instrument task and for the time to complete a flight lesson. The preliminary trend indicates that the PCATD is effective in teaching basic and advanced instrument tasks to private pilots, which replicated the findings of an earlier study by Taylor and colleagues. As a result of prior training in an FTD and a PCATD time to a stage check or an instrument rating flight check flight was less when compared to an airplane Control group.

INTRODUCTION

In an earlier study by Taylor, Lintern, Hulin, Talleur, Emanuel and Phillips (1996), a commercially available Personal Computer Aviation Training Device (PCATD) was evaluated in a transfer of training experiment to determine its effectiveness for teaching instrument tasks. The data indicated that transfer savings for both the number of trials to reach a criterion performance for instrument tasks and time to complete a flight lesson were positive and substantial for new instrument tasks. A comparison of instrument rating course completion times resulted in a saving of about four hours in the airplane as a result of prior training in the PCATD. As a result of the Taylor et al. (1996) study, a Federal Aviation Administration advisory circular published in 1997 permits 10 hours of instrument training to be completed in an approved PCATD.

To evaluate transfer of training effectiveness of a flight training device (FTD), the performance of subjects trained on instrument tasks in an FTD and later trained to criterion in an airplane must be compared to the performance of subjects trained to criterion only in the airplane. Roscoe (1971) demonstrated that the transfer effectiveness ratio (TER) accounts for the amount of prior training in ground trainers by specifying the trials/time saved in the airplane as a function of the prior trials/time in the ground training. The purpose of the present study is to use an incremental transfer of training research design to measure the effectiveness of a flight training device (FTD) and a Personal Computer Aviation Training Device (PCATD) to determine the point at which additional training in a FTD or a PCATD was no longer effective.

METHOD

Participants

In the initial proposal a total of 180 pilots (30 in each of the 6 groups) were scheduled to participate in the study. Due to funding reductions in the second and third years, the number of pilots in the study was reduced to a total of 120 pilots (20 subjects in each group). Due to the elimination of FY 2005 funding the best case of the number of subjects currently ranges between 16 and 20. The subjects are University of Illinois, Institute of Aviation private pilot students, who are enrolled in the Institute's instrument program. To date 91 students have completed the study. Each semester the students are assigned equally to the six groups while maintaining a balanced number of subjects across all groups to account for students who drop out of the course prior to completion. There are four FTD (Frasca) groups, one PCATD group, and the Control group. All students in AVI 130 and 140 will be involved in the study.

Apparatus

Training in the FTD is being conducted in four Frasca 141 FTDs with a generic single-engine, fixed-gear, and fixed-pitch propeller performance model. The PCATD training is being conducted using FAA approved PCATDs from Aviation Teachware Technologies (ELITE) v. 6.0.2, with flight controls by Precision Flight Controls. These PCATDs simulate the flight characteristics of the Piper Archer III aircraft. Airplane training will be carried out in the Piper Archer III aircraft, which is a single engine, fixed-pitch propeller, fixed undercarriage aircraft.

Procedure

The instrument training program at the Institute of Aviation is divided into two courses: AVI 130, Basic Instruments and AVI 140, Advanced Instruments. AVI 130 emphasizes aircraft control and instrument departure, enroute and approach procedures, while AVI 140 emphasizes NDB holds and approaches, GPS procedures, and partial panel procedures. The students received 45 hours of lectures during the semester for both courses. For both courses, the students also received 15 flight lessons, each of which were programmed for one lesson per week. Experimental curricula for both courses were developed for the four FTD groups, the PCATD groups and the Control group.

Using an incremental transfer of training design, six groups of subjects were tested in the airplane for proficiency on various instrument flying tasks in both courses. Four of the groups received 5, 10, 15, and 20 hours of prior

instrument training in a FTD, respectively. One group received 5 hours of prior training in the PCATD. The prior training was distributed equally between AVI 130 and AVI 140. A Control group received all training in the airplane. Instrument training using the FTD and PCATD was administered to the four FTD groups and the PCATD group during four flight lessons for each semester.

Prior to the start of each semester, all flight instructors were standardized on the use of the FTD and PCATD, changes in the training course outlines (TCOs), and experimental procedures. Flight instructors served as both instructors and data collectors. They rated student performances on designated flight tasks in the aircraft. For performance assessment in the aircraft, each instructor recorded if the student met the completion standards during the execution of the designated flight tasks. They also recorded the number of trials to criterion for specific tasks and flight time to complete a flight lesson (Phillips, Taylor, Lintern, Hulin, Emanuel & Talleur, 1995). Four check pilots, blind to the allocation of students to training conditions, were used to conduct the AVI 130 stage check and the AVI 140 instrument rating flight check.

Each flight instructor was instructed to schedule a stage check after Flight Lesson 40 in AVI 130, and an instrument rating flight check after Flight Lesson 55 in AVI 140 when the student was judged to be able to meet the proficiency standards for the stage check and the instrument proficiency check, respectively. These check flights permitted the assessment of the differential time to complete the flight course as a function of the amount of prior training in the FTD and the PCATD. Those students who failed the evaluation flight or failed to meet the proficiency standards by Flight Lesson 45 (stage check) and Flight Lesson 60 (instrument rating check flight) were provided additional flight time to reach proficiency. Dependent measures were trials in the airplane to proficiency, time to complete the flight lessons in the airplane, and total course completion time in the airplane for both courses.

Mean number of trials to reach criterion in the airplane for selected instrument tasks and mean time to complete the flight lesson in the airplane were computed for all groups for both courses. After all students have completed the study, separate Analyses of Variance (ANOVAs) will be performed to analyze the difference between the six groups on the three dependent measures for both AVI 130 and 140. ANOVAs will be used to determine the significance of the trial variable and flight lesson completion time variable as a function of experimental treatment for both AVI 130 and AVI 140. Finally, ANOVAs will explore variability in the time to a successful check flight for the AVI 130 and AVI 140 courses as a function of the experimental treatment for the four groups (Airplane, PCATD, FTD 5 and 10 groups) that received only prior training on instrument tasks . To further identify the locus of any significant effects, post–hoc tests will be employed to make specific pair wise comparisons using Tukey's test of significance.

PRELIMINARY RESULTS

At this time, all students, a total of 124, have completed and taken the final check ride the AVI 130 Basic Instruments course. This is an increase from 65 from last year's report. Table 1 shows the results of the check ride for the six groups for the fall 2002, spring, summer and fall 2003, and spring 2004 semesters. A total of 75 students passed the check ride on the first attempt and 49 students passed on the second attempt. Nine students have been recommended for a remedial course, AVI 102. The total dual flight time to completion for AVI 130 (the basic instrument course) for the six groups is shown in Table 1 and in Figure 1. The average dual flight time to course completion for the Airplane Group was greater than the average time for each of the five experimental groups who had prior training in the PCATD or the FTD. The Airplane group required 22.35 hours of dual to complete the course while the five experimental groups, after prior training in the PCATD or the FTD, the dual flight time in the airplane ranged between 18.31and 20.87 hours. A total of 95 students have completed and taken the final check ride (the instrument rating flight check) for the AVI 140 Advanced Instruments course. Table 2 shows the results of the check ride. A total of 48 students passed the check ride on the first attempt and 40 students passed on the second attempt. There were no students recommended for remedial training (AVI 102) in the summer 2004 session. The total dual flight time to completion for the six groups for the advance instrument course (AVI 140) is shown in Table 2 and in Figure 2. The average course completion time for the Airplane Group is greater for each of the five experimental groups who had prior training in the PCATD or the FTD. The Airplane group required 26.02 hours of dual to complete the course while the hours to completion for the five experimental groups ranged from the dual flight time in the airplane ranged between 25.77 - 20.11 hours after prior training in the PCATD or the FTD. Statistical analyses based on current data indicate no significant differences between the three experimental groups that received prior training on instrument tasks and the Control group.

DISCUSSION

The trend from the data from the current study thus far indicates that the FTD and the PCATD appear effective in teaching basic and advanced instrument tasks to private pilots but the limited number of subjects has prevented this trend from reaching statistical significance. With the limited number of subjects and the current variability among subjects the power is low. If this trend is confirmed this study will systematically replicate the findings of Taylor et al. (1996, 1999) that PCATDs are useful to teach instrument tasks to private pilots. As a result of prior training in an FTD

and a PCATD time to the stage check in AVI 130 and to the instrument rating flight check was less for all experimental groups when compared to a Control group trained only in the airplane. One purpose for conducting an incremental transfer of training study is to determine at what point additional training in the FTD and the PCATD in no longer effective. The amount of data collect thus far does not permit statistical analyses. When additional data are available we hope to be able to answer the question of how can flight schools most effectively use the 10 hours of instrument training time currently permitted by AC No: 61-126 (FAA, 1997). Taylor et al. (1996, 1999) suggested allocating the time to the training of the following instruments tasks: steep turns, intersection holds, ILS, VOR, DME ARC and LOC BC Approaches, NDB holds and approaches, and holds and approaches using partial panel. A study by Taylor, Talleur, Emanuel, Rantanen, Bradshaw and Phillips (2002) clearly indicated that the use of 5 hours of PCATD time was cost-effective based on the allocation of PCATD time for these tasks for the PCATD 5 group, but the results of the 10 nor the 15 hour groups indicated that it was not an effective use of the additional five hours of time. Flight schools should examine their TCOs to determine where the additional 5 hours could be effectively used. There is also the probability that PCATDs can be used effectively for teaching cross-country procedures where there is the possibility of a one–to–one transfer of training for time. The current project is evaluating the effectiveness of using FTDs for 5 and 10 hours of cross-country flight. The data thus far indicate that additional FTD time can be effectively used during cross-country flight.

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Table 1.Flight Lesson 45 Statistics (Fall, 2002, Spring, Summer, Fall 2003 and Spring 2004)

	Airplane Only	PCATD 5.00	Frasca 5.00	Frasca 10.00	Frasca 15.00	Frasca 20.00
Number of Students	22	20	22	20	21	19
% First Flight Pass Rate	59.00 (N=13)	65.00 (N=13)	45.45 (N=10)	75.00 (N=15)	76.19 (N=16)	42.11 (N=8)
% Second Flight Pass Rate	100.00 (N=9)	100.00 (N=7)	100.00 (N=12)	100.00 (N=5)	80.00 (N=5)	100.00 (N=11)
Students Recommended 102	0	0	1	1	4	3
Total Dual to Completion	22.35 (N=22)	20.20 (N=20)	19.27 (N=22)	20.87 (N=20)	18.36 (N=21)	18.31 (N=19)
Variance Total Dual to Completion	9.39	6.40	10.03	14.17	9.87	9.48

Note: This lesson is the final check ride for AVI 130.

Table 2. Flight Lesson 60 Statistics (Spring, Summer, Fall, 2003, Spring, Summer 2004)

	Airplane Only	PCATD 5.00	Frasca 5.00	Frasca 10.00	Frasca 15.00	Frasca 20.00
Number of Students	17	17	17	15	13	16
% First Flight Pass Rate	47.06 (N=8)	52.94 (N=9)	52.94 (N=9)	40.00 (N=6)	46.15 (N=6)	62.50 (N=10)
% Second Flight Pass Rate	100.00 (N=9)	75.00 (N=6)	100.00 (N=6)	88.89 (N=8)	100.00 (N=7)	66.67 (N=4)
Students Recommended 102	2	3	4	2	4	2
Total Dual to Completion	26.02 (N=17)	25.77 (N=16)	24.55 (N=15)	23.78 (N=15)	22.18 (N=13)	20.11 (N=15)
Variance Total Dual to Completion	15.10	6.43	7.74	8.87	11.25	11.30

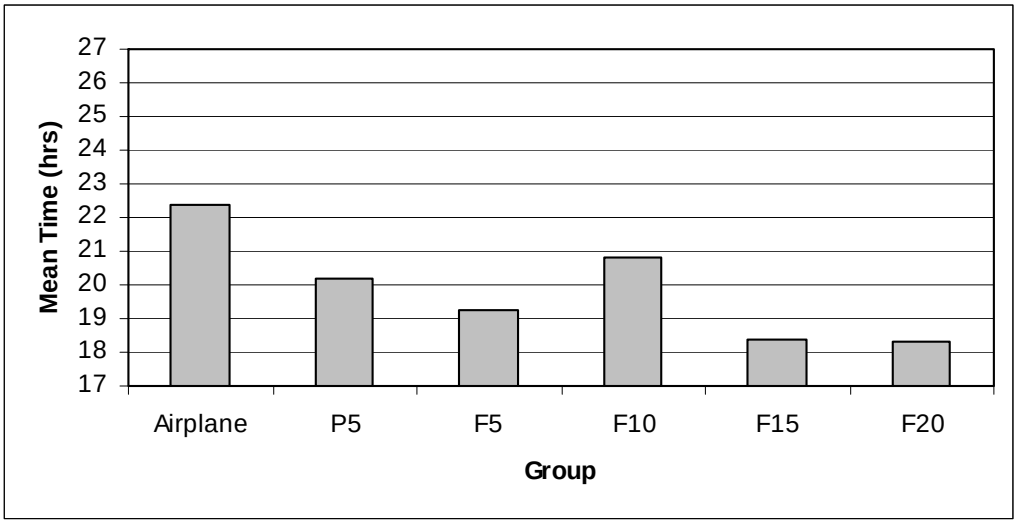

Figure 1. Flight Lesson 45 Statistics (Fall, 2002, Spring, Summer, Fall 2003, and Spring 2004)

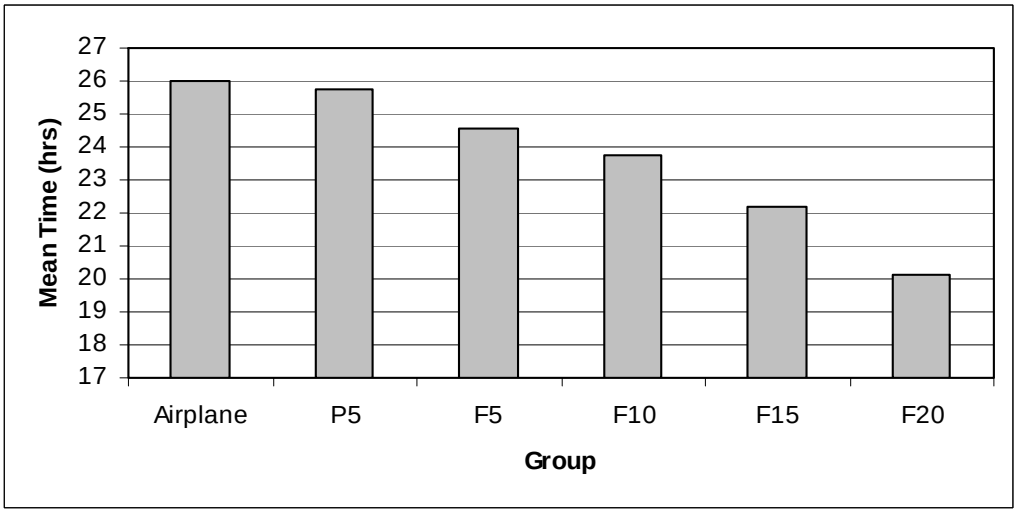

Figure 2. Flight Lesson 60 Statistics (Spring, Summer, Fall, 2003, Spring, Summer 2004)